

Supplementary material

Deep-sea benthic structures and substrate types influence the distribution of functional groups in the Wallaby-Zenith Fracture Zone (East Indian Ocean)

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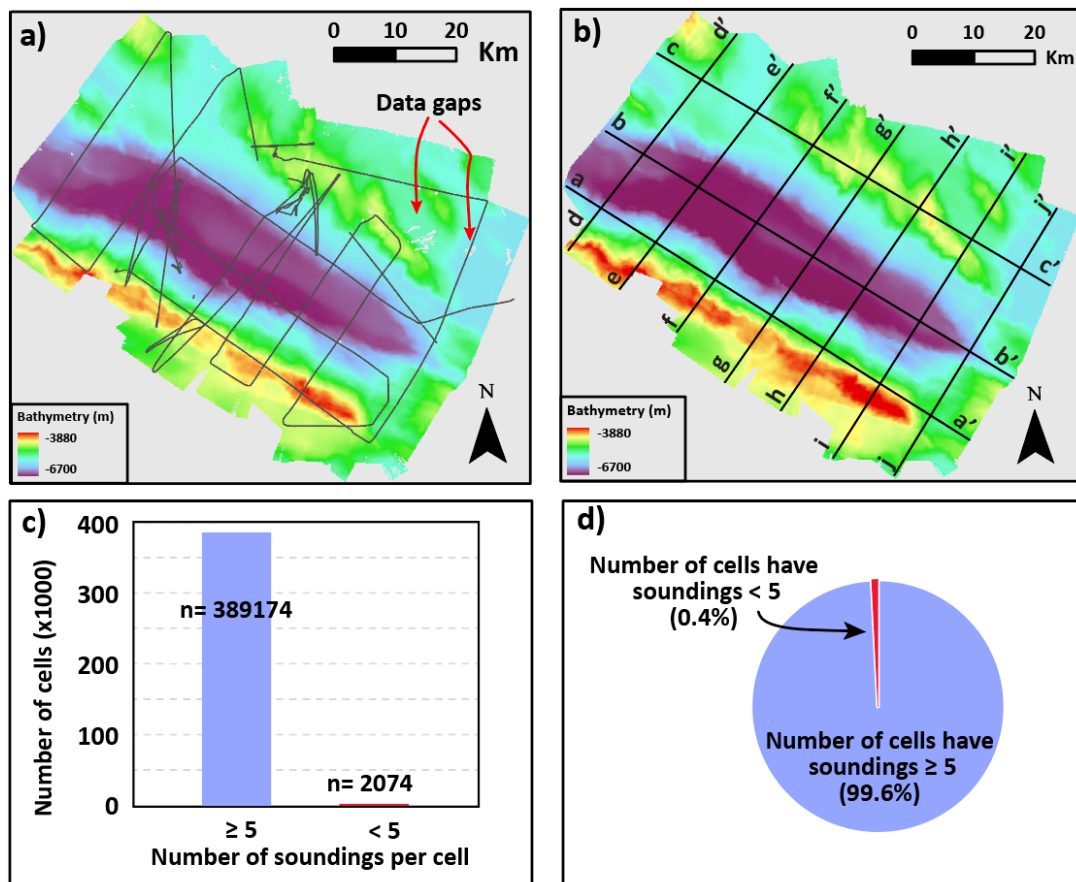


Figure S1. (a) Vessel trackline of the surveyed area showing the data gaps in the corner. (b) Processed bathymetry with the gaps filled using 3×3 matrix sizes. (c) Histogram and (d) pie chart showing the sounding density of the bathymetry with 100 m cell size. Cross sections a-a' to j-j' represent the locations of profiles shown in Figure S3.

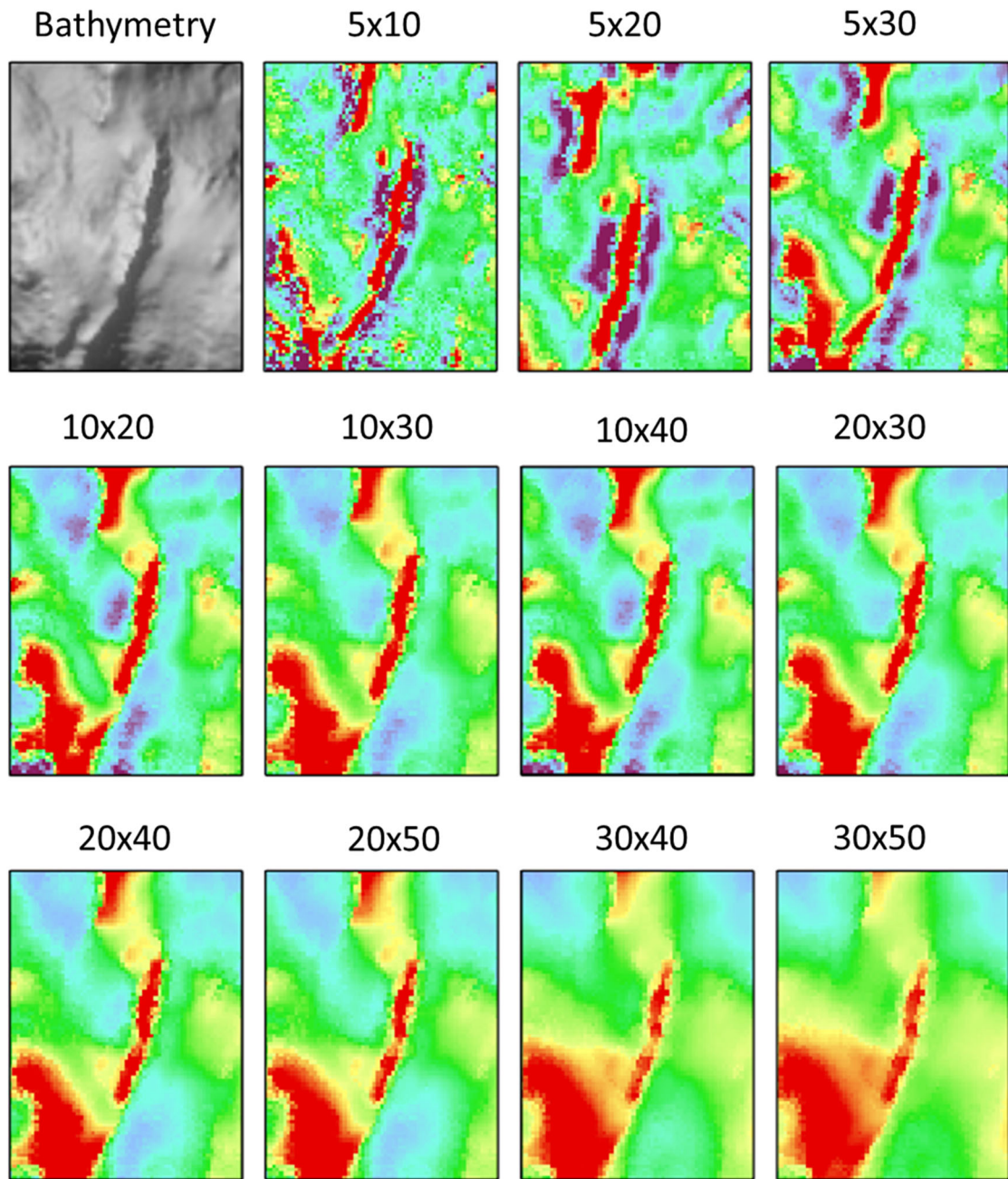
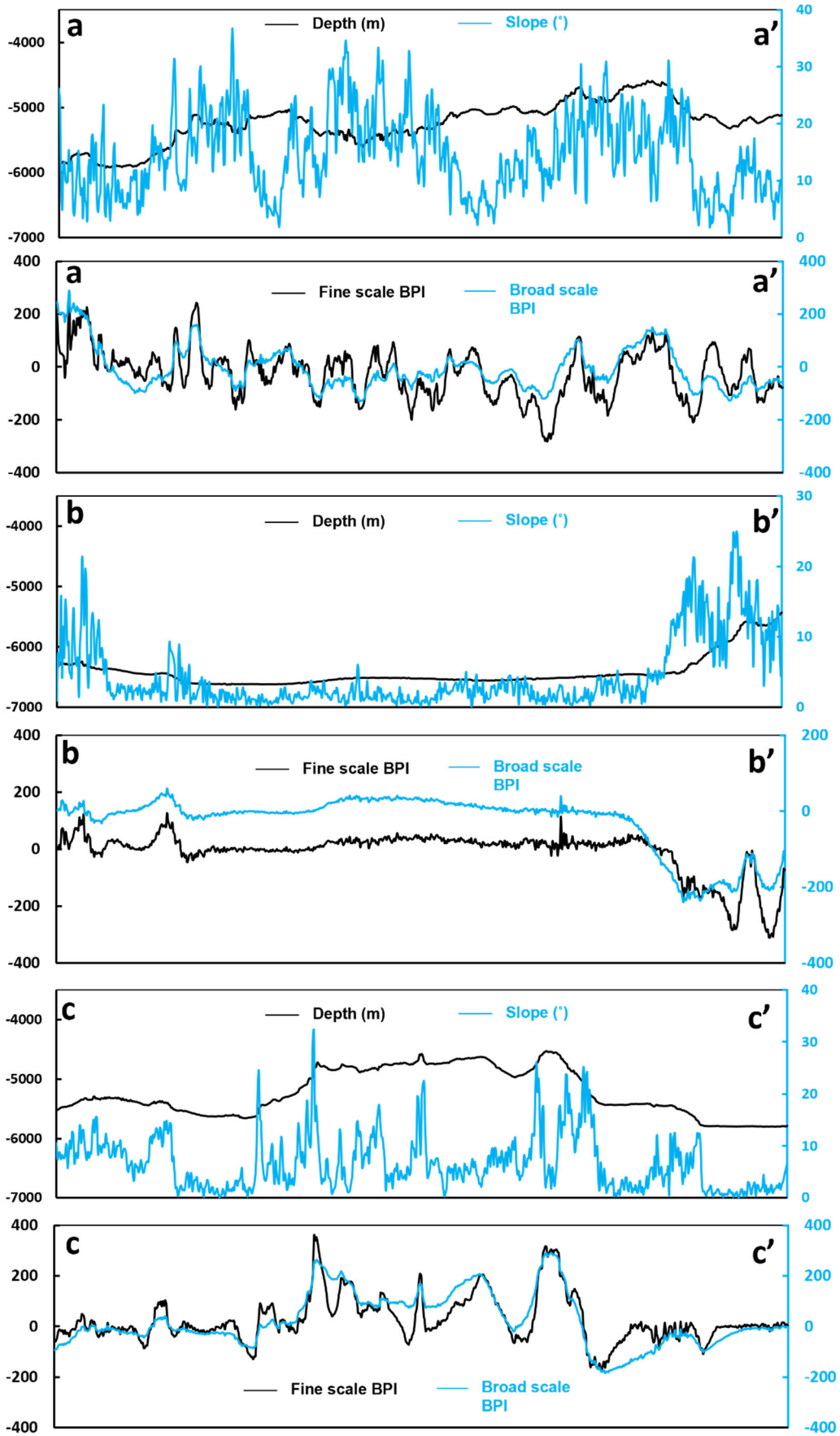


Figure S2. Bathymetry and bathymetric position index (BPI) calculated using different inner and outer radiuses to show the selection of BPI scale factors for fine and broad scale BPIs. Fine scale details are lost after the inner and outer radiuses 10×20 and the broad structural trends remain at the 20×50 scale.



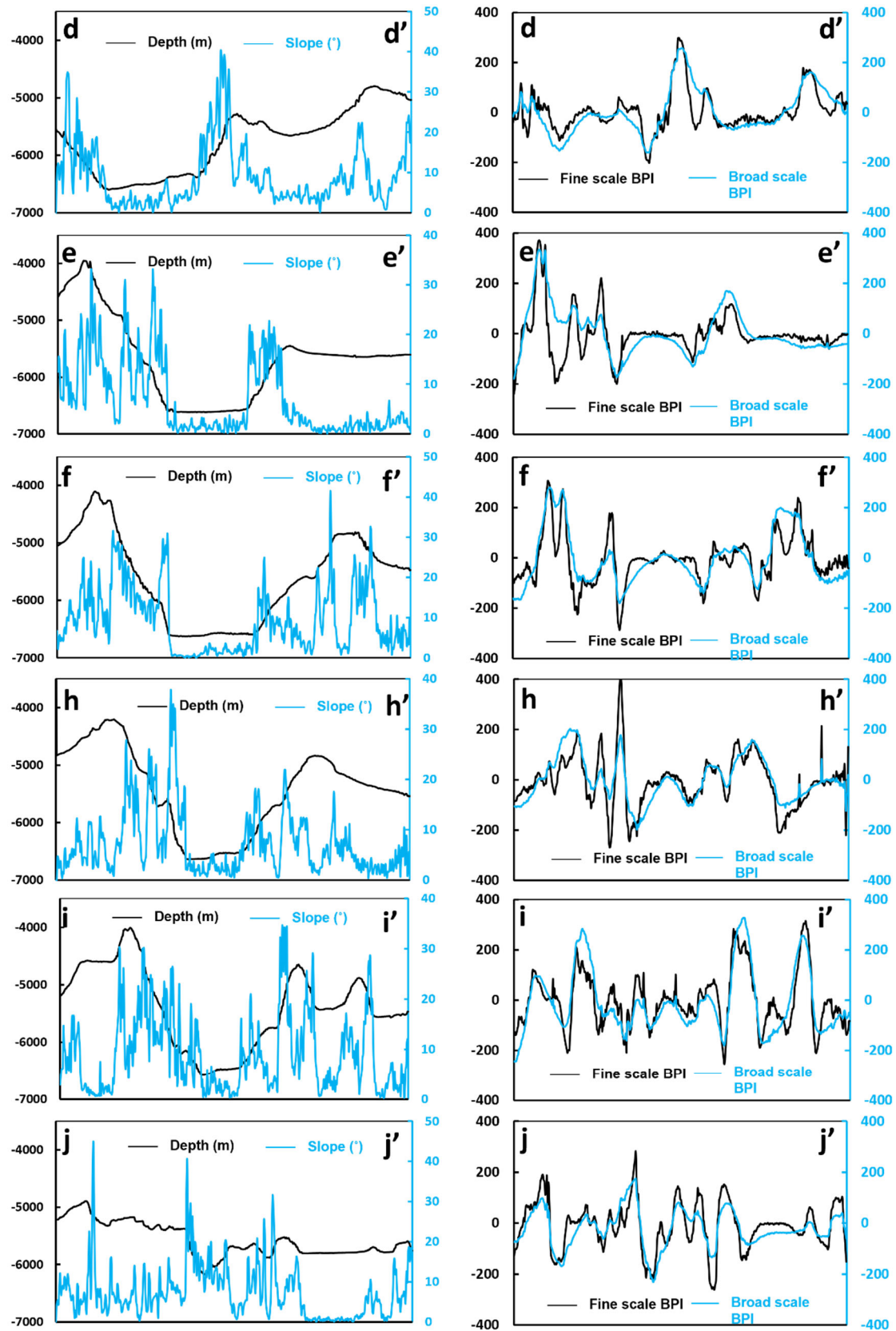


Figure S3. Transects delineated across the WAFZ and terrain derivatives such as Slope, Broad BPI and Fine BPI. Locations of each cross section is shown in Figure S1d. Profile along transect g-g' is not shown in this figure as it appears in the manuscript.

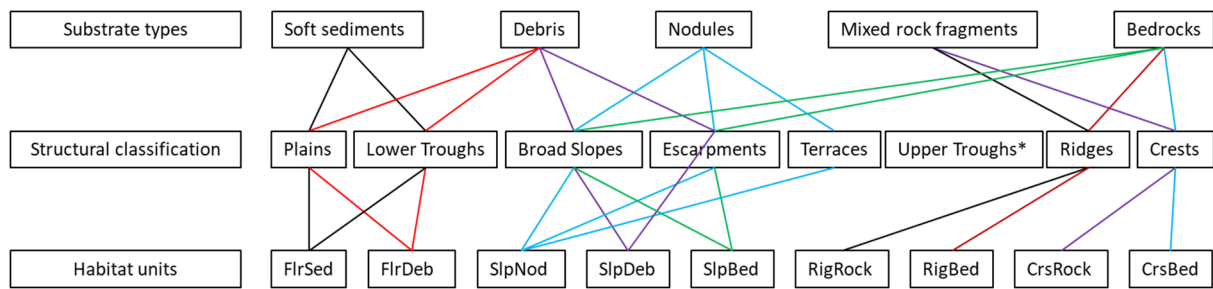


Figure S4. Scheme showing the definition of the habitat unit based on the substrate types that observed within specific structural classes.

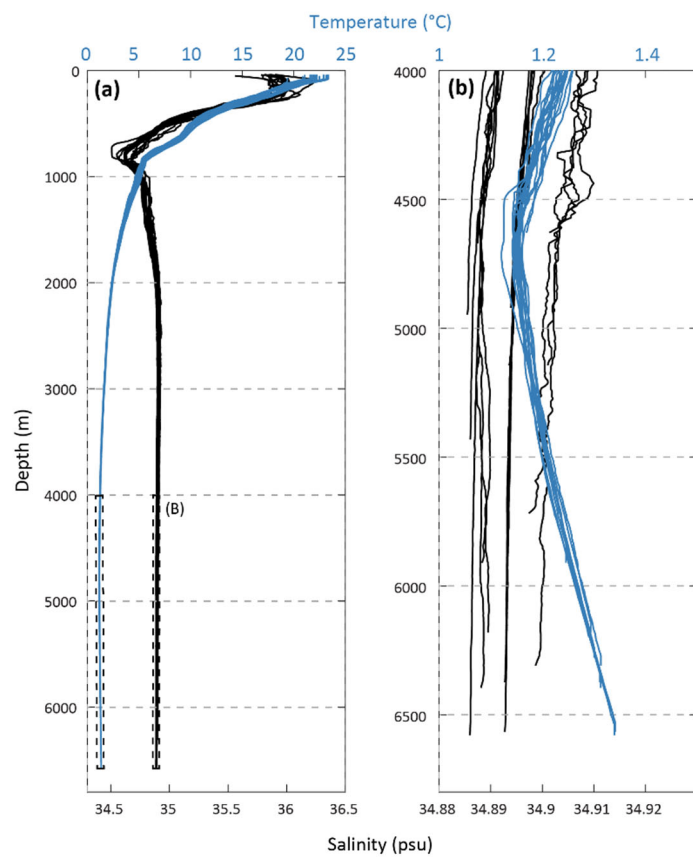


Figure S5. (a) Temperature (blue) and salinity (black) over depth, from the surface to the deepest point of the lander and submersible dives. The dashed box in (a) represents the data shown in (b).

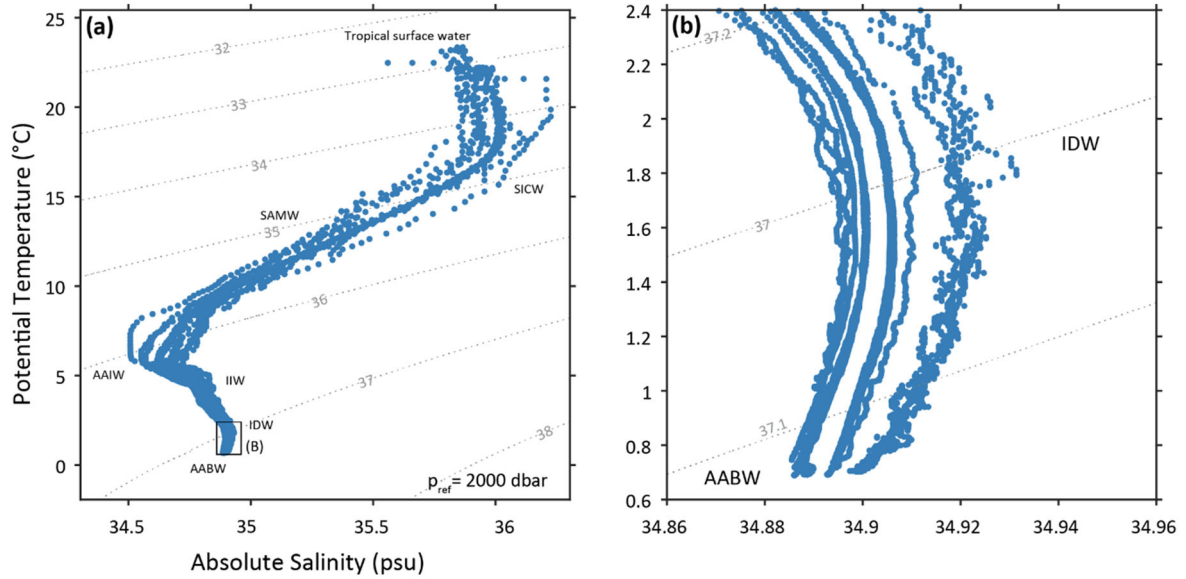


Figure S6: Θ -S PLOT (a) and magnified between 3,500 and 5,600 m. The dashed box in (a) represents the data shown in (b).

The deepest submersible dive depth was 6576 m on May 18, 2021, and the shallowest dive was 4926 m on May 22, 2021, as measured by the CTD (**Error! Reference source not found.**). Temperature and salinity from all six LF dives and 12 lander deployments between May 15 and May 22, 2021, exhibited similar conditions over the water column. *In-situ* temperature decreased from approximately 23°C at the surface to 10.5°C at 470 m, before reaching 5.5°C at 830 m. Between 830 m and 4600 m the temperature decreased at a rate of $\sim 1.2^\circ\text{C}/1000\text{ m}$ before *in-situ* temperature increased to $\sim 1.34^\circ\text{C}$ for the deepest dive (**Error! Reference source not found.a**). Absolute salinity (SA) was a maximum of ~ 36.2 psu at 130 m, before reaching a minimum of ~ 34.5 psu at 800 m. From 800 m to 2200 m, SA increased monotonously to 34.91 psu before decreasing at a slow rate to reach conditions comparable to the bottom by 4500 m, where the variation is < 0.04 psu (**Error! Reference source not found.b**). The mean bottom conditions varied; at the north ranging between 1.14 – 1.21°C and 34.89 – 34.9 psu, at the centre between 1.27 – 1.47°C and 34.87 – 34.92 psu, and at the south ranging between 1.14 – 1.2°C and 34.88 – 34.9 psu.

The Θ -S analysis (Figure S3) indicates high salinity upper waters of South Indian Central Waters (SICW) followed by the dominant Southern Annual Mode Water (SAMW) around 14°C (Talley et al., 2011). Antarctic Intermediate Water (AAIW) is recognised as the low salinity layer below the thermocline. The maximum salinity layer below the AAIW is Indian Intermediate Water (IIW) originating from the Banda Sea (Rochford, 1966). Indian Deep Water (IDW) is cooler in temperature and higher in salinity, located below the IIW (Talley, 2013). The coldest, deepest water is dense-modified AABW (Mantyla and Reid, 1995; Reddy, 2001).

Table S1. Correlation matrix of features four bathymetric derivatives.

Bathymetric derivatives	Bathymetry	Fine scale BPI	Broad scale BPI	Slope
Bathymetry	1	0.20666	0.32556	0.26407
Fine scale BPI	0.20666	1	0.56053	0.07306
Broad scale BPI	0.32556	0.56053	1	0.11344
Slope	0.26407	0.07306	0.11344	1